Why do discount rates differ? Analyzing the differences between discounting policies for transport Cost-Benefit Analysis in five practices

Abstract

This paper aims to explain why discounting policies applied in Cost-Benefit Analysis (CBA) for transport infrastructure projects differ, by analyzing the discounting policies for five countries being the Netherlands, the United Kingdom, Norway, Sweden and Denmark. These five practices are analyzed through studying the country's transport appraisal Guidelines and interviewing experts. A secondary goal of this study is exploring the implications of the results for discounting policies and applied CBA. This study concludes that discounting policies vary significantly. The differences can be explained by empirical arguments, practical arguments, political-administrative arguments as well as (differences in) judgments. Ethical arguments did not play a role. Since CBA is intrinsically a normative instrument, the political-administrative and judgmental character of discounting policies in itself is not a problem, as long as this is articulated in the Guidelines. However, this study concludes that the political and judgmental character of discounting policies is poorly communicated, which prevents decision makers from assessing the judgments made, from disagreeing with this judgment and from asking for a recalculation of the CBA based on a discount rate which coincides with their own belief system. In this paper solutions for improving the communication of this judgmental character are discussed. Another conclusion of this paper is that – although the Guidelines emphasize that the intention is to base the discount rate entirely on empirical information, the empirical arguments which underpin the discounting policies contradict existing literature. The implication of this result is that the applied discount rates are contestable, which impairs the validity of CBA results. Hence, the recommendation is to critically assess and reconsider the elements of discounting policies which contradict with literature.

Keywords: Cost-Benefit Analysis; CBA and ethics; Transport Appraisal; Discount rate; Discounting policy; Policy Analysis; Project Appraisal.

1. Introduction

Cost Benefit Analysis (CBA) has a long tradition as a widely used instrument, informing decision makers of the societal costs and benefits of carrying out transport infrastructure investments (e.g. Börjesson et al., 2014; Salling and Banister, 2009; Welde and Odeck, 2011). In a CBA the discount rate is the most decisive parameter. The rate often determines whether a project passes the benefit-cost test (e.g. Arrow et al., 2014; Gollier 2012a). Several contributions can be found in existing literature which compare discount rates applied in several practices around the world (e.g. Boardman et al., 2013; Mackie and Worsley, 2013; Naess, 2006; Olsson et al., 2012). The main conclusion that can be drawn from these studies is that countries use very different discount rates. However, to the best of the author's knowledge, there is as yet no contribution in scientific literature which explains why discount rates differ between practices. This paper contributes to scientific knowledge because the discounting policies of five countries being the Netherlands, the United Kingdom, Norway, Sweden and Denmark are scrutinized and an explanation is given as to why the discount rates between these practices differ.

This study is not only relevant from a scientific perspective. The societal contribution is that practitioners within the five practices included in this study can learn why the discount rates applied in the different practices deviate from each other. Subsequently, one can confront the rationales

employed in the different practices. Through this confrontation learning effects can sprout in three ways. Firstly, when one learns that the rationale used in another practice is 'better', improvements can be made by transplanting the rationale. Secondly, if – after the confrontation – representatives from two countries conclude that their own rationale is superior, the result of the confrontation is that the rationale for the domestic practice is underpinned in a better way, which can be considered as a learning effect. Thirdly, if both practices have some favorable features, one can try to combine these features and create the 'best of both worlds'. It goes without saying that practitioners from other practices in which CBA is applied (e.g. France, New Zealand, Australia, United States, Chile and Japan) can also benefit from this study by confronting the rationales that are employed in their practice with the rationales of the five countries analyzed in this study. Also, a discussion of the rationales used in mature practices can be informative for practitioners from countries that aspire to institutionalize CBA in their practice or for countries that are (re)designing their Guidelines. To further enhance the societal contribution of this study, a secondary goal is to explore the implications of the results for applied Cost-Benefit Analysis.

The remainder of the paper is organized as follows: section 2 discusses the methodology. Section 3 outlines general discounting concepts. Section 4 discusses the discounting policies. Section 5 compares the discounting policies in the five CBA practices. Section 6 aims to explain the differences between discounting policies. Section 7 explores the implications of the results. Finally, section 8 concludes and provides recommendations for further research.

2. Methodology

As it would be almost impossible to analyze and compare the discounting policies of all of the countries worldwide that apply CBA within a reasonable period of time, the discounting policies of five countries (the Netherlands, the United Kingdom, Norway, Sweden and Denmark) have been selected and are analyzed in this study. These countries were selected because they are regarded by several scholars as countries with serious (and well-documented) CBA track records (e.g. Mackie and Worsley, 2013; Odgaard et al. 2005), which enhances the feasibility of meeting this study's research goals. However, it cannot be claimed that the results of this study are, by definition, representative for all countries worldwide applying CBA for their transport projects as, before carrying out this study, it proved very difficult to identify the extent to which the discounting policies of the five countries are a representative sample.

To analyze the five discounting policies (and explain the differences) transport appraisal Guidelines were examined and 34 CBA experts were interviewed (seven from Sweden, nine from Denmark, Norway and the United Kingdom). An exception to the methodology applied in this study is that for the analysis of the Dutch practice no CBA experts were interviewed, since Dutch experts were already interviewed on this topic in a previous study (Mouter et al., 2013). Subsequently, the discounting policies are compared and the differences are analyzed. To explain the differences, the extent to which the nature of the arguments underpinning the discounting policy divergences are examined, amongst other things. To explore the implications of the results of this analysis for discounting policies and applied CBA, the results were then looked at in the light of existing literature.

The 34 experts interviewed for this study[1] were academics and policy makers who have experience with transport CBAs. When the discounting policy was not communicated in an English language publication, the interviews were used to reveal the policy. Moreover, respondents were asked about the underpinning of the discounting policy applied, about the process of deciding upon the discounting policy and to reflect on the policy's merits.

The respondents were recruited in two rounds. In the first round, one clear CBA proponent, one clear CBA antagonist and one policy maker were interviewed. The rationale was that the CBA proponent and antagonist could provide divergent perspectives on their practice and the policy maker would be able to provide detailed information with respect to procedures. The respondents were asked who else needed to be interviewed in order to obtain a complete picture of their practice. In the second round, the people put forward by the first round respondents were interviewed and also asked to reflect on the observations made by the respondents interviewed in the first round to improve the reliability of the results. The reliability of the results for the Dutch practice was verified by presenting the main results for this reference group at a Dutch conference and a meeting with CBA experts from different Dutch Ministries.

3. Discounting policies: general concepts

Before embarking on a discussion of the discounting policies employed in the five practices, this section outlines concepts which apply to all of the discounting policies under scrutiny.

3.1 Two theoretical frameworks

The choice of the discount rate can be based on both ethical considerations and empirical information (e.g. Arrow et al., 1995; Kaplow et al. 2010; Goulder and Williams, 2012). Determining the discount rate is an empirical assessment when one aspires to ground the discount rate in actual behavior of people. On the other hand, determining the discount rate is an ethical matter when one believes that the rate should be based on ethical considerations about the way project effects in the future (ethically) should be valued compared to project effects in the present.

Two theoretical frameworks can be used for determining the discount rate based on empirical information being 'the opportunity cost of capital approach' and 'the consumer behavior approach' (Hagen et al., 2012). Following the 'opportunity cost of capital approach' the risk-free discount rate may be interpreted as the additional consumption one would have achieved after a period by depositing one euro in the bank or investing it in another interest-bearing investment instead of consuming it now (Hagen et al., 2012). Following the second theoretical framework – the 'consumption behavior approach' – the risk-free discount rate reflects the rate at which individuals are willing to trade consumption in the future for today. The discount rate can be expressed through the so-called Ramsey rule:

$$d = p + L + \mu g$$

[1] 31 interviews were telephone interviews. Three Danish respondents preferred to answer questions and follow up questions via e-mail.

where d denotes the discount rate, p is the rate of pure time preference[2] (also coined as the rate of impatience), L reflects the possibility that, because of a future exogenous calamity (for example, an asteroid hitting the earth), some future generations might not ever arrive (Goulder and Williams, 2012), g is relative consumption growth per capita and μ describes how fast the marginal utility of consumption declines as consumption increases. Subsequently, the discount rate can be determined by estimating the parameters in the Ramsey equation.

If there were no distortions (e.g. taxes) or inefficiencies in markets, the 'consumption behavior approach' and the 'opportunity cost of capital approach' would compute the same risk-free discount rate (e.g. Arrow et al., 2013; Gollier, 2012a). Given that distortions exist in any economy, it would be extremely surprising if the two rates were the same (Baumol, 1986). Hence, there is an apparent problem of choosing between them (Pearce and Ulph, 1999).

In existing literature, both approaches are often discussed as justifiable frameworks (e.g. Arrow et al., 2013). However, the 'consumption behavior approach' is often mentioned as the preferred theoretical framework (e.g. Gollier 2012a; Groom et al., 2005), since, as a result of market distortions, capital markets do not reflect consumer preferences very well. A second downside of the 'opportunity cost of capital' approach is that bonds with maturities longer than thirty or fifty years do not exist in any significant quantity on sufficiently liquid markets, which makes it difficult to infer a risk-free discount rate for projects with long time horizons (Gollier, 2012a). Despite these downsides, leading scholars in the field believe that the risk-free discount rate, computed using the 'opportunity cost of capital' approach, can provide a 'reality check' on the risk-free discount rate computed using the 'consumption behavior approach' (Arrow et al., 2012).

3.2 Determining the discount rate is always an ethical judgment

Determining the discount rate can be an empirical assessment but deciding on the discount rate is always an ethical judgment, since it captures how much one cares about the well-being of future generations compared to the well-being of the present generation (e.g. Arrow et al, 1995; Heal and Millner, 2014). As such, the discount rate depends on the social welfare function, which is unique to each person, much like the moral legitimacy of the death penalty or abortion rights; it is the kind of thing reasonable people may reasonably disagree about (Heal and Millner, 2014). A key ethical issue on which scholars disagree is the extent to which the social welfare function – and thus the discount rate – should be grounded in actual behaviour. Some scholars (e.g. Nordhaus, 1994;) argue that there is no (ethical) justification for choosing a social welfare function – and thus a discount rate – which is not fully grounded in actual behavior. These scholars argue that the discount rate derived from the empirical assessment should also be used to evaluate the social welfare effect of a policy option.

Other scholars claim that the choice of the discount rate should be based almost entirely on ethical considerations (e.g. Stern, 2008). For these scholars, there is no need to link the discount rate with observed behavior. In their view, determining the pure rate of time preference (p) is a normative rather than an empirical question: 'how much should future well-being count, relative to current well-being, in the social welfare function?' This implies that a positive value for p means that - all other things being equal - the further into the future we go, the less worth we attach to the well-being of people living there. Many scholars argue from a normative perspective that the pure rate of time preference should be zero (e.g. Broome, 1992; Gollier, 2012a; Solow, 1974; Ramsey, 1928). For

[2] The rate of pure time preference reflects individuals' preference for consumption now, rather than later, with an unchanging level of consumption per capita over time.

instance, Ramsey (1928) states that: *'it is assumed that we do not discount later enjoyments in comparison with earlier ones, a practice which is ethically indefensible and arises merely from the weakness of the imagination*'. Ramsey viewed discounting as unethical for the social planner because when horizons are long and one discounts, the future agent whom the social planner serves disappears (Shively, 2002). From an ethical perspective, the variable μ in the Ramsey equation can be interpreted as a measure of society's relative aversion to intertemporal inequality (e.g. Gollier, 2012a; Goulder and Williams, 2012). The more weight society gives to equality between generations, the higher the value of the parameter (Arrow et al., 1995).

Another ethical argument put forward by John Rawls is that the whole idea of calculating a 'correct' or 'efficient' discount rate is a mistake (van Liederkerke, 2004). From a Rawlsian perspective one should first answer what a just and fair distribution of savings between generations could be and then continue to look for the discount rate which meets this aim. People who are charged with setting the discount rate should forget the mathematical frame and ask themselves what justice between generations entails then do the math (van Liederkerke, 2004). Shively (2002, p.5) also suggests 'do the ethics before the math': *'If discounting provides a result to which we object later on ethical grounds, we might conclude that discounting was an inappropriate tool for use'.* Various authors argue from a normative perspective that countries ought not to use a (high) discount rate, since this results in 'a dictatorship of the present over the future' (Chichilnisky, 1997), an unsustainable future (e.g. Gowdy, 2010; Pigou, 1932), breaches principles of intergenerational justice (e.g. Davidson, 2006) and requires a worldview that neglects issues of fairness and equity, especially across generations (Shively, 2002).

3.3 Additional general concepts

In the five practices, some general concepts are applied in manifold (albeit in different forms). To avoid repetition in the country descriptions, these general discounting concepts are briefly discussed in this section. Among significant scholars in the field there is strong consensus that the risk-free discount rate (the first general concept discussed) should decline over time (e.g. Atkinson and Mourato, 2008; Arrow et al., 2014; Boardman et al., 2013). The most prominent rationale for a declining risk-free discount rate is that the large uncertainty associated to aggregate consumption in the distant future (parameter 'g' in the Ramsey equation) should induce the prudent representative agent to use lower rates to discount more distant cash flows (Gollier, 2012b). It is often suggested in the literature that economic agents are time inconsistent if the term structure of the discount rate[3] is decreasing. According to Gollier (2012a) this is not the case as long as the consumer's rate of time preference (p) is constant. Arrow et al. (2014) argue that time inconsistency can be eliminated when estimates of the discount rate are regularly updated.

Subsequent to the decision on the risk-free discount rate, practices have to decide whether they prefer to discount risky projects with a higher discount rate or discount these projects against the risk-free discount rate and communicate the project's risks to the decision-maker using other methods. The argument in existing literature (e.g. Damodaram, 2008; Gollier, 2012a) for discounting risky project effects with a higher discount rate compared to safe project effects is the observation that people are risk averse and therefore prefer certain over uncertain future effects. In existing

[3] The term structure of the discount rate can be defined as the curvature of the discount rate. When the discount rate diminishes over time, the term structure is decreasing and the term structure of the discount rate is flat when the discount rate does not change over time.

literature, there is consensus that only non-diversifiable risks should be considered in the discounting policy of Cost-Benefit Analyses (e.g. Arrow and Lind, 1970; Damodaram, 2008; Gollier 2012a). Non-diversifiable risk is the risk of the project that cannot be diversified away, since it correlates with the aggregate risk (also coined as the macro-economic risk) of the government portfolio. Risks that can be fully diversified away in the government portfolio are not relevant for establishing the discounting policy, since adding the risk to the portfolio does not increase its riskiness (Arrow and Lind, 1970).

Moreover, there is consensus in the literature that a project's non-diversifiable risks can correlate both in a positive and a negative way with the aggregate risk. In the case of positive correlation, the risk premium is positive and in the case of a negative correlation, implementing the project reduces the aggregate risk. It therefore has an insurance value, which takes the form of a negative risk premium (Gollier 2012a).

In addition, scholars agree that risks should not be double counted in discounting policies. However, according to Damodaram (2008) it is all too common for public or private actors to double – or even triple – count risk in simulations and base decisions upon the wrong type of risk. Moreover, Damodaram (2008) states that it is important that risk is not double counted, since it is patently unfair to risky investments to discount their cash flows back at a risk adjusted rate and to then reject them because the variability in value is high.

An aspect of discounting policies on which leading scholars disagree is the term structure of the risk premium in the discount rate. Gollier (2012b) argues that the same arguments proposed in scientific literature to justify a decreasing term structure for the risk-free discount rate – parametric uncertainty of consumption growth (parameter g) – also justifies an increasing term structure for the risk premium. In contrast, Weitzman (2012) argues that the risk premium should be declining, reflecting the increasing relative value of having insurance against the increasingly likely possibility over time of disastrous outcomes. Hultkrantz et al. (2014) argue that Weitzman's paper takes the lead on a road that scientists should follow. Finally, the Capital Asset Pricing Model – which is heavily criticized in existing literature (e.g. Gollier, 2012b; Hagen et al., 2012) – assumes that the term structure of the risk premium is flat.

Another topic on which scholars disagree is 'discounting environmental goods'. Weitzman (1994) favors discounting environmental goods at a lower rate (dual discounting approach). Arrow et al. (1995) claim that there is no reason for explicitly modifying the discount rate for environmental goods as long as valuations for these goods are adjusted when they enhance over time. Van Wee (2011) concludes that both proposed directives do not provide different CBA results.

4. Results: the discounting policies of five countries

This section describes the discounting policies of the five selected countries. The description of the Dutch, British, Norwegian and Swedish discounting policies are based on the country's appraisal Guidelines and related documents. The description of the Danish practice is fully based on statements made by respondents in the interviews, since no English language Guideline or document describing the Danish discounting policy was available. The absence of such a document clarifies why the Danish country description is relatively short.

4.1 The Netherlands

In 2007, a study group for actualization of the discount rate (Dutch Ministry of Finance, 2007) was commissioned to reconsider the discount rate, since it was observed that the nominal interest rate (3.8%) was lower than the risk-free discount rate applied at that time (4%) and that as a result of

the high risk-adjusted discount rate (7%), no projects aimed at mitigating climate change were viable. The study group recommended 'the opportunity cost of capital' as a theoretical framework to determine the discount rate, arguing that a virtue of this framework is that the discount rate is determined in a transparent and objective way which might enhance the acceptance for the identified discount rate in the Dutch CBA-community. The study group established that the current real interest rate observed in financial markets (2%) should be used as a starting point to determine the risk-free discount rate. Since additional analyses carried out by the study group pointed at higher future real interest rates than 2%, a 2.5% risk-free discount rate was deemed to be 'administratively durable'. The Minister of Finance endorsed this advice and stated that adjusting the risk-free discount rate should be reconsidered in 2011 when the real interest rate would be lower than 1% or higher than 4% for a longer period of time (Dutch Ministry of Finance, 2007). In August 2011, the Minister of Finance determined that the real interest rate had been lower than 1% for a longer period of time. However, the risk-free discount rate was not altered, since real interest rates in periods of economic crisis were not deemed to be useful for determining the risk-free discount rate (Dutch Minister of Finance, 2011).

In the Netherlands, the risk-free discount rate is adjusted for non-diversifiable risk. A standard risk premium of 3% was estimated using the Capital Asset Pricing Model. The Dutch general CBA Guideline (Romijn and Renes, 2013) states that CBA analysts are allowed to estimate a project-specific risk premium. However, this Guideline observes that in practice this was never done and only the standard risk premium was used. Hence, the risk adjusted discount rate used in the Netherlands is 5.5%. Based on an econometric analysis by Aalbers (2009), the effects of a transport project on climate change and non-renewable resources are discounted with a lower risk adjusted discount rate (4%). Another feature of the Dutch policy is that macro-economic risk is not only handled via the discount rate but also via estimating a project's costs and benefits for at least two future scenarios. However, a supplement to the prevailing CBA Guideline at that time (Dutch Ministry of Finance and CPB, 2003) concluded that CBA analysts should either estimate the effects of a project using scenarios that differ in macro-economic growth, or adjust the discount rate for macro-economic risk, to avoid double counting. The directive to choose for either incorporating macro-economic risk via a risk premium in the discount rate or to capture it via scenario analyses was endorsed by de Zeeuw et al. (2008). However, in 2012 a specialized Guideline for appraising infrastructure projects with CBA (Dutch Ministry of Infrastructure and the Environment, 2012) determined that it would be obligatory for CBA analysts to incorporate macro-economic risk in the discount rate and estimate costs and benefits using two scenarios that have largely different assumptions when it comes to macro-economic growth expectations, without making any reference to the warning in the 2004 supplement (Dutch Ministry of Finance and CPB, 2003) that this results in double counting.

4.2 United Kingdom

In the UK practice, the Greenbook (Treasury of the United Kingdom, 2003) establishes that the costs and benefits are discounted with a declining discount rate (3.5% for the period 0-30 years, 3% for the period 31-75 years and 2.5% for the period 76-125 years). The Greenbook discusses how the 'consumer behavior approach', expressed through the Ramsey rule, is used as a framework to derive the 3.5% discount rate for the period 0-30 years. According to the Greenbook, evidence suggests a pure rate of time preference (p) around 1.5%, an annual growth in per capita consumption of around 2% and elasticity of marginal utility of consumption at around 1. The elasticity of marginal utility of consumption is derived from Pearce and Ulph (1999), amongst others, estimating a range

from 0.7 - 1.5 and Oxera (2002), estimating a range from 0.8 to 1.1. The key references used to underpin the rationale for declining discount rates are discussed in the Oxera (2002) report.

In the past, the British discount rate included a risk premium. However, it was concluded during the revision that it was a better solution to address relevant risk specifically for each project through various risk analysis methods, such as quantified risk analysis (Hagen et al., 2012). The Green Book assumes that, given the size of national income relative to the scale of most individual projects, the cost of variability of individual projects is usually negligible (Treasury United Kingdom, 2003). Hagen et al. (2012) observe that this claim is not underpinned with specific reasons or references.

4.3 Norway

The Hagen et al. (2012) committee recommends a risk-free discount rate of 2.5% for the first 40 years and a risk-free discount rate of 2% after 40 years. To determine the discount rate the leading scholars worldwide on this topic were invited to discuss the state-of-the-art literature with the Hagen et al. (2012) committee. The committee concluded – referring to Gollier (2008) and Weitzman (1998), for instance – that there is a strong argument put forward in existing literature for applying a declining risk-free discount rate. Moreover, Hagen et al. (2012, p.61) concluded that exising literature did not give a firm answer to the question as to what the risk-free discount rate should be: "*Different estimates and assumptions as to the parameter values included in the Ramsey condition may produce very different estimates as to the required rate of return. Harrison (2010) shows that different sources arrive at required rates of return that range from 1.4 percent to 8 percent…. This illustrates that there is no straightforward answer to what is an appropriate discount rate when using this simple approach."* Hence, it was decided to use 'opportunity cost of capital' as the theoretical framework to decide upon the discount rate (Hagen et al., 2012, p.77): "*There is no one correct way of providing specific estimates for the risk-free market interest rate, the risk premium and the time profile of interest rate developments. However, a reasonable approach may be to assume that it will, under normal market conditions, be possible to secure a risk-free real interest rate of 2.5 percent within a time span of 40 years through investments in the international financial market."* In Norway, it was decided to discount environmental goods with the same rate as non-environmental goods. However, the value of environmental goods increases over time using resource scarcity as an argument.

Hagen et al. (2012, p.68) recommended that projects should be discounted using a standard risk-adjusted discount rate, since the outcome of the former regime – estimating the specific risk adjustment for individual projects – was only followed in a small number of cases, resulting in major projects discounted at the risk-free discount rate, which was evaluated as undesirable. Moreover, the committee concluded that for determining the risk premium in the discount rate, the CAPM was no longer useful, arguing, amongst other things, that the model assumes that all assets are tradable and have a market price, whilst large parts of national wealth are not tradable and that the model failed to predict how investors act and how financial markets work. Since it was decided not to use the CAPM for determining the risk premium, the Hagen et al. (2012, p.70) committee searched through existing literature for an alternative solution and established a declining term structure of the risk premium, sustaining their argument in a discussion paper by Weitzman (2012). Hagen et al. (2012) assume that a transportation measure has a risk profile that is somewhat closer to a government bond than to an average project funded via the stock exchange and conclude that a risk-adjusted real required rate of return on government bonds of 4% is reasonable. Consequently, the committee recommended a discount rate of 4% for the first 40 years (2.5% risk-free and 1.5% risk

premium), a discount rate of 3% for years 41 – 75 (2% risk-free and 1% risk premium) and after 75 years a risk-free discount rate of 2% is used.

4.4 Sweden

In the 2012 revision of the Swedish ASEK Guidelines (Swedish Transport Administration, 2012), the advisory group of scientific experts recommended that the discount rate should remain at 4%, but the Director General of the National Transport Administration decided to reduce it to 3.5% (Hultkrantz et al., 2014). Consequently, the Guidelines (Swedish Transport Administration, 2012, p. 9) recommend using a social discount rate of 3.5%, arguing that although there are many different views on what the size of the social rate of discount should be, there is a consensus that the Ramsey model should be used as a starting point for determining the discount rate. Subsequently, the discount rate can be determined by estimating the parameters in the Ramsey equation. The ASEK Guidelines state that it is reasonable to make the same assumptions for the consumer's rate of time preference and the numerical value of the elasticity of marginal utility of consumption as the British Greenbook (Treasury United Kingdom, 2003) and the European HEATCO recommendations (HEATCO, 2006). The third parameter in the Ramsey equation – the relative consumption growth per capita – was estimated using the expected annual growth in GNP per capita (about 1.8% until 2050). Based on the Ramsey model, a discount rate of 3.28% was estimated (Hagen et al., 2012).

The ASEK Guidelines outline that – although there are scientific arguments for using a declining social discount rate (e.g. Weitzman., 2001 and Gollier., 2002) – Sweden works with a constant discount rate, since using a declining discount rate leads to practical complications as the modelling tools used for CBA are not designed to handle variable discount rates. Moreover, the Guidelines state that macro-economic risk may be an argument for a higher discount rate compared to the rate determined by the Ramsey equation. Based on the estimation using the Ramsey equation as well as discussions about risks and declining discount rates, a flat discount rate of 3.5% was established (Swedish Transport Administration, 2012).

4.5 Denmark

The discount rate is determined by the Minister of Finance. Quite recently the discount rate was reduced to 4% (3% risk free and 1% risk premium). Also, it was decided that the discount rate should decline after 35 years and 70 years. After 35 years costs and benefits should be discounted at a rate of 3% (2.5% risk free and 0.5% risk premium) and after 70 years costs and benefits are discounted with a risk free rate of 2%. The decision to incorporate a declining discount rate – and a declining risk premium – was influenced by recommendations of the Hagen committee. The argumentation used by this committee was transplanted to the Danish practice (see section 4.3 for a discussion of the arguments).

4.6 Respondents' reflections on discounting policies

To generate deeper insight into the rationales for the various discounting policies 34 experts (seven from Sweden, nine from Denmark, Norway and the United Kingdom) in the field of transport appraisal were asked about the underpinning of the applied discounting policy in their practice.

An important observation was that not many respondents were able to articulate the precise rationale for the discounting policy. Moreover, interviews with Norwegian and British respondents only lead to a few additional insights into the discounting policy's rationales. One of the Norwegian respondents stated that the final decision to implement a risk-free discount rate of 2.5% 'came out of

thin air' and a British respondent labelled the underpinning of the British discount rate as 'fuzzy'. To the contrary, interviews with Swedish and Danish respondents lead to new perspectives, since they observed that the applied discount rate in their country is predominantly an outcome of a political-administrative process and not of an impartial scientific exercise. Below, these observations will be discussed in more detail.

Three respondents state that in Sweden the discount rate is not centrally determined by the Ministry of Finance. After a discussion with other Administrations (such as the Environmental Administration), at the end of the day it was the Director General of the Transport Administration who decided on the discount rate which should be used in CBAs for the transport sector. According to the respondents, the Director General selected the lowest possible discount rate that he could reasonably justify, since he realized that the CBA results for infrastructure projects are enhanced when a low discount rate is used. One Swedish respondent stated the following: *"my concern is that the decision about the parameters is taken by the Director General of the Transport Administration. I don't question him as an individual but the fact that the decisions on the parameters are actually taken by people with interests in the results of CBA studies is not very good, I think".*

Four Danish respondents emphasized the political character of the decision about the discount rate in their practice. The Minister of Finance decided upon the rate after severe negotiations. According to one respondent, the Ministry of Finance was reluctant to reduce the discount rate (which used to be 6%), since from their point of view, money is best kept in the Treasury and a low discount rate potentially enhances the CBA scores of many projects, which gives project proponents an argument to fund the project. However, people argued in the media that discount rates should be lowered for three reasons. Firstly, the real interest rate was lower than zero. Secondly, as a result of the high discount rate, no projects aimed at mitigating climate change (e.g. subsidize electric vehicles) were viable. Thirdly, the Great Belt Company had government secured loans and had borrowed money at 1.5-2% for many years. One respondent stated that in the coalition agreement between the three government parties it was stated that they should take a look at the discount rate and there was huge pressure on the Ministry of Finance to lower the rate.

In conclusion, both Danish and Swedish respondents emphasize the fact that political-administrative bargaining processes play a vital role in the establishment the applied discount rate in their practice. Discounting policies were established after negotiations between actors preferring a low discount rate (e.g. the Swedish Transport Administration) – since this results in their projects performing better in CBAs – and the Ministry of Finance, which favors a high discount rate, since this will lead to low CBA scores and, accordingly, a better argument to keep money in the Treasury. Moreover, respondents discuss that the political-administrative negotiations are both fueled and restricted by empirical observations. Danish respondents argued that the discussion on the discount rate catalyzed after it was discovered that the real interest rate was significantly lower than the existing risk-free discount rate. Hence, a situation in which results from empirical observations or (academic) studies dispute the soundness of the existing discount rate is perfect soil for a reopening of a bargaining process to adjust the discount rate. Besides fueling debate on the discount rate, empirical observations also set the boundaries for the 'discounting policy bargaining process'. For instance, from the analysis of the Swedish practice it can be seen that the Director General of the Transport Administration selected the lowest possible discount rate which he could reasonably justify.

5. Comparison of the five practices

The characteristics of the practices are summarized in Table 1 below. To provide an indication of what the differences in discounting policies mean for CBA results, the net present value of a hypothetical transport project with 1.4 billion construction costs and net yearly benefits of 50 million was calculated for a time horizon of 100 years (see the final row).

Table 1: Characteristics of discounting policies for the five practices

	Netherlands	**United Kingdom**	**Norway**	**Sweden**	**Denmark**
Which theoretical framework is used?	Opportunity cost of capital	Consumer behavior approach	Opportunity cost of capital	Consumer behavior approach	Opportunity cost of capital
What is the (declining or constant) risk-free discount rate?	Constant risk-free discount rate of 2.5%	Declining risk-free discount rate: 3.5%: years 0-30 3%: years 31-75 2.5%: years 76+	Declining risk-free discount rate 2.5%: years 0-40 2%: years 41+	Constant risk-free discount rate of 3.5%. However, arguments for declining discount rate are implicitly considered	Declining risk-free discount rate 3%: years 0-35 2.5%: years 36-70 2%: years 71+
Is macro-economic risk incorporated in the discount rate?	Constant standard risk premium of 3%, also macro-economic risk is handled via scenarios	Macro-economic risk is not handled via the discount rate	Declining standard risk premium is incorporated in the discount rate 1.5%: years 0-40 1%: years 41-75	Macro-economic risk is not handled explicitly in the discount rate but is considered implicitly in discounting policy	Declining standard risk premium is incorporated in the discount rate 1%: years 0-35 0.5%: years 36-70
Are 'environmental goods' discounted with another rate?	Yes, climate change effects and effects on non-renewable resources are discounted with a lower discount rate	No	No	No	No
What is the discount rate schedule?	5.5% for the full time horizon	3.5%: years 0-30 3%: years 31-75 2.5%: years 76+	4%: years 0-40 3%: years 41-75 2%: years 76+	3.5% for the full time horizon	4%: years 0-35 3%: years 36-70 2%: years 71+
NPV for project with 1 billion costs and 50 million yearly benefits	-445 million	+93 million	-64 million	+33 million	-43 million

Table 1 shows that the resulting discount rate schedules (sixth row) for the Scandinavian countries and the United Kingdom appear to be rather similar. However, based on the calculation of the net present value of the fictive project it is possible to conclude that the (relatively small) differences in discount rate schedules significantly affect net present values, which confirms the proposition of Heal and Millner (2014) that seemingly small differences in the discount rate yield very different CBA outcomes and thus policy recommendations. Moreover, it can be concluded that the discount rate schedule applied in the Netherlands deviates from the other countries, which has a major effect on the net present value calculated.

Moreover, table 1 shows that the discounting policies vary significantly between the countries. The three most significant differences will be highlighted. Firstly, the discounting policies differ with respect to incorporating macro-economic risk into the discount rate. In the United Kingdom risk is not handled via the discount rate, in Sweden risk is only handled implicitly, in the Netherlands a standard premium of 3% is incorporated and both Norway and Denmark apply a declining risk premium which commences at a rate of 1.5% (Norway) or 1% (Denmark). The second

component on which discount rates significantly differ is the starting percentage of the risk-free discount rate (the risk-free discount rate in year 1). The discount rate schedules in the United Kingdom and Sweden start with a higher risk-free discount rate than the other countries. Thirdly, the United Kingdom, Denmark and Norway apply a declining risk-free discount rate, whereas Sweden considers the arguments for a declining discount rate only implicitly in their discounting policy and the Netherlands does not apply a declining risk-free discount rate.

6. Explaining the differences in discounting policies

To explain the three main differences between discounting policies highlighted in section 5, the arguments which underpin these components are outlined in table 2. Five types of arguments are distinguished: 1) **Empirical arguments**; 2) **Judgment based on inconclusive empirical evidence**: when empirical evidence does not provide a definite answer one needs to make a discretionary choice based on the inconclusive empirical evidence; 3) **Unspecified judgment:** a discretionary decision is made without any specific references to empirical evidence; 4) **Political-administrative argument:** fostering political or administrative goals is the underlying reason for a decision(s) with respect to a country's discounting policy; 5) **Practical argument** is used to underpin the discount rate.

Table 2: arguments for discounting policies distinguished by their nature

Arguments underpinning the starting percentage of the risk-free discount rate	**Netherlands (2.5%):** -Real interest rate observed in financial markets used as a starting point **(empirical)** -Real interest rates in times of economic crisis are not useful **(unspecified judgment)** -'Opportunity cost of capital' framework is acceptable for CBA community **(political-administrative argument)** -2.5% discount rate is 'administratively durable' **(political-administrative argument)** **United Kingdom (3.5%):** -Risk-free discount rate is based on results of (academic) studies, which provide ranges for the parameters of the Ramsey equation **(judgment based on inconclusive empirical evidence)** **Norway (2.5%):** No one correct way of providing specific estimates for the risk-free market interest rate. Reasonable approach seems to be to assume a 2.5% risk-free discount rate based on return in international markets **(judgment based on inconclusive empirical evidence)** **Sweden (3.5%):** -Reasonable to make same assumptions as UK and HEATCO for estimating two parameters in Ramsey equation **(judgment based on inconclusive empirical evidence)** -Relative consumption growth based on expected annual GDP growth **(empirical)** **Denmark (3%):** -Recommendations of Norwegian Hagen committee were transplanted to Danish practice **(judgment based on inconclusive empirical evidence)**
Arguments underpinning the decision to use a constant or declining risk-free discount rate.	**Netherlands (constant):** Using a declining discount rate is not considered in the Guidelines **United Kingdom (declining):** Declining discount rate underpinned with academic literature **(empirical)** **Norway (declining):** Declining discount rate underpinned with academic literature **(empirical)** **Sweden (constant):** -Modelling tools used for CBA are not designed to handle variable discount rates **(practical)** -Discount rate was determined based on discussions about risks and a declining discount rate (**unspecified judgment)** **Denmark (declining):** -Recommendations of Norwegian Hagen committee were transplanted to Danish practice **(empirical)**
Arguments underpinning the decision to incorporate a premium for macro-economic risk in the discount rate (or not)	**Netherlands (3%)**: -Standard risk premium based on CAPM **(empirical)** **United Kingdom (0%):** -Given the size of the national income, contribution of an individual project to the macro-economic risk seems to be negligible **(unspecified judgment)** **Sweden:** -Discount rate was determined based on discussions about risks and a declining discount rate (**unspecified judgment)** **Norway (1.5% years 0-40, 1% year 41-75):** -Risk premium based on academic literature **(empirical)** **Denmark (1% years 0-35, 0.5% years 36-70):** -Recommendations of Norwegian Hagen committee were transplanted to Danish practice **(empirical)**

Table 2 shows that the starting percentages of the risk-free discount rates applied in the five practices are underpinned with **empirical arguments**, **political-administrative arguments** and **judgmental arguments**. However, based on the observations presented in table 2, the extent to which the three types of arguments explain the deviations between countries cannot be established.

Since table 2 reveals that the risk-free discount rate in all five practices is based on both **empirical evidence** and **judgment**, it is conceivable that differences can be explained by both empirical characteristics (e.g. real interest rate differs between country A and country B) and by differences in judgments made (e.g. which risk-free discount rate is selected based on the inconclusive empirical evidence?).

A **practical reason** explains why the United Kingdom, Norway and Denmark use a declining discount rate and Sweden does not use a declining discount rate. The Swedish modelling tools used for CBA are not designed to handle variable discount rates. Dutch Guidelines do not specify why the Netherlands does not use a declining discount rate.

Both **empirical arguments** and **differences in judgment** explain why countries have different policies with respect to handling risk in the discount rate. The Netherlands uses a different method for estimating the risk premium than Norway and Denmark, which is an empirical explanation. Based on unspecified judgment, the United Kingdom and Sweden decided not to handle risk via the discount rate.

In addition to the explanations listed above, Swedish and Danish respondents emphasize that **political-administrative arguments** played a vital role in the establishment of the discounting policy. However, respondents were not able to fully explain which components of the discount rate were (not) influenced by these negotiations. Nevertheless, for both practices it can be concluded that the applied discount rate is influenced by the relative power of institutions preferring a high discount rate compared to institutions preferring a low discount rate. No proof was found to show that administrative negotiations influence the Norwegian and British discounting policies. No direct proof was found to prove that political-administrative bargaining played a significant role in the establishment of the Dutch discount rate. However, there are indications that the process is by all means not a purely scientific exercise. Firstly, political-administrative arguments are used to underpin the applied risk-free discount rate (see table 2, first row). Secondly, all members of the Dutch study group for the actualization of the discount rate in 2007 were civil servants and not academics. Thirdly, although in 2007 it was prescribed by the Dutch Ministry of Finance (2007) that the discount rate should be lowered in 2011 if the real interest rate was lower than 1% for a longer period of time, the discount rate was not lowered in 2011 even though this condition was met. This is an indication that the Dutch Minister of Finance was reluctant to reduce the discount rate, despite empirical evidence pointing in that direction.

In conclusion, empirical arguments, practical arguments, political-administrative arguments and (differences in) judgment explain why discount rates differ. Hence, empirical evidence does not exhaustively explain differences between discounting policies. Finally, table 2 shows that ethical arguments were not used to underpin discounting policies.

7. Discussion and implications

This section discusses the results of this study and explores the implications of the results for applied Cost-Benefit Analysis and discounting policies. Section 7.1 elaborates on the empirical arguments underpinning the discounting policies. Section 7.2 addresses this study's observation that discounting policies were not underpinned with ethical arguments and ponders the non-empirical

arguments used to underpin discounting policies being practical, political-administrative and judgmental arguments.

7.1 Discussion of empirical arguments

Although this study shows that discounting policies are not based entirely on empirical evidence, all practices are empirically based, implying that an attempt is made to fully ground the discount rate in actual behavior of individuals via the theoretical frameworks 'opportunity cost of capital' or 'consumer behavior approach'. To explore the extent to which these empirical arguments are in line with results from the literature, Table 3 shows – for the different components of discounting policies – which practices are in line with or contradict the existing literature discussed in section 3.3.

Literature	**Practices following literature**	**Practices contradicting literature**
Both 'consumption behavior approach' and 'opportunity cost of capital' are justifiable theoretical frameworks for determining a risk-free discount rate, but the former is prevalent.	**UK, NO, SW, DE** follow 'consumer behavior approach' or 'opportunity cost of capital'.	**NL** argues that the 'opportunity cost of capital' framework is followed and that the real interest rate should be used as a starting point. It was argued that real interest rates in periods of economic crisis are not useful for determining the risk-free discount rate. However, no alternative rationale was provided. As a consequence, the Dutch risk-free discount rate is not underpinned at present.
Consensus that the risk-free discount rate should decline over time.	Adopted explicitly in **UK, NO and DE** and implicitly in **SW**.	**NL** does not apply a declining risk-free discount rate.
Only non-diversifiable risks should be considered in discounting policies.	Adopted explicitly in **NL, NO and DE** and implicitly in **SW.**	Non-diversifiable risk is not incorporated in **UK** discounting policy since it was argued that non-diversifiable risk is usually negligible for individual projects. This is convincing for marginal projects but is indefensible for multi-billion projects such as High-Speed 2. As a result of the project's size, not all the risks can be diversified away. Although various risks were thoroughly analyzed in the Economic Case for High Speed 2 (Department for Transport United Kingdom, 2013) the project's contribution to the macro-economic risk wasn't considered. Hence, not incorporating risk via the discount rate probably means that the CBA results for projects that contribute heavily to the aggregate risk are too optimistic.
Non-diversifiable risks can correlate in both a positive and a negative way with the aggregate risk.		Guidelines of **NO, NL and DK** endorse this principle. However, it is emphasized in the Guidelines that in practice they do not follow the directives of the Guidelines, which implies that CBA analysts do not estimate the specific risk premium for an individual project and only use a standard risk premium. Hence, there is no conflict between what is in the literature and what is in the CBA Guidelines with respect to this component of the discounting policy. However, what is given in the literature and what is practiced in these countries is conflicting.
Consensus that risks should not be double counted.		In **NL** aggregate risk is handled both via 'a risk adjusted discount rate' and 'scenario analysis'. It is conceivable that risk is double counted in **NO** and **DE** as well, since 'risk adjusted discount rate' and 'sensitivity analysis' are combined.
Leading scholars disagree on whether the term structure of the risk premium should be increasing or decreasing. CAPM, assuming a flat term structure, is criticized.	In, **NO and DE** the term structure of the risk premium is decreasing.	**NL** uses the controversial CAPM for estimating the risk premium in the discount rate and thus employs a flat term structure.
Leading scholars disagree on whether environmental goods should be discounted at a lower rate, or that valuations for environmental goods should	Only **NL** adopted the 'dual discounting approach'. **UK, NO, SW, DE** opt for enhancing valuations.	

enhance over time. Both approaches are justifiable.		

Table 3 shows that several empirical arguments underpinning discounting policies contradict with existing literature. The first implication of this result is that it is possible that the countries under scrutiny in this study carry out CBAs based on incorrect discount rates, which contests the validity of CBA results. This was an unexpected result of this study, considering the emphasis in the Guidelines to base the discount rate entirely on empirical information and the observation of several scholars that the five countries under scrutiny in this study have a serious CBA track record (e.g. Mackie and Worsley, 2013). Bearing in mind the decisive impact of the discount rate on CBA outcomes, the misalignment between the discount rates employed in the five countries and the literature is alarming.

7.2 Discussion of non-empirical arguments

Before embarking on a discussion of the judgmental, practical and political-administrative arguments, the absence of ethical arguments in the underpinning of the discounting policies will be addressed. Despite the fact that determining the discount rate is always an ethical exercise and the existence of abundant ethical literature with respect to determining discounting policies, no ethical arguments were used to underpin the discounting policies under scrutiny in this paper. A statement along the lines of 'for ethical reasons we select discount rate X' was not found in any CBA Guidelines. The only document discussing ethical arguments is an underlying study supporting the British discounting policy (Oxera, 2002) which outlines ethical arguments for applying a zero pure rate of time preference. However, the British Guideline does not discuss these arguments explicitly (Treasury of the United Kingdom, 2003; p.97): *'other literature suggests it lies between 0.0 and 0.5. However, if zero, this implies pure time preference does not exist, which is not regarded as plausible'.* In fact, the British Guideline evades the ethical question as to whether a pure rate of time preference 'ought' to be included. Accordingly, this argument suffers from the "is-ought fallacy", articulated by David Hume, which implies that just because something is a certain way, it does not necessarily mean that it ought to be that way.

This study shows that – in contrast to the ethical arguments – 'judgment' plays a significant role in the establishment of discount rates. Although Guidelines emanate a clear intention to ground the discount rate entirely in empirical information[4], Guidelines also discuss that a judgmental decision based on the available empirical evidence is inevitable, since empirical information does not provide conclusive evidence for a particular discount rate. This study demonstrates that discounting policies are not only established based on 'inevitable judgment', but also on 'unspecified judgment', which implies that discretionary decisions were made without any specific references to empirical evidence.

For both types of judgmental arguments the judgment is poorly underpinned. Guidelines articulate that a 'plausible choice' (United Kingdom) or a 'reasonable choice' (Sweden and Norway) was made based on the available empirical evidence without specifying why this decision was

[4] For instance, the Dutch Guideline states explicitly that an empirically based discount rate might add to the view that the discount rate is established in an objective way, which might enhance the acceptance for the discount rate in the Dutch CBA-community (see section 4.1).

'plausible' or 'reasonable' (and why another decision on the discount would be 'unreasonable' or 'implausible'). This makes it difficult for the reader to decide whether s/he agrees with the reasonableness of the judgment. To illustrate, the Swedish Guidelines state that it is reasonable to make the same assumptions as the British Greenbook (Treasury United Kingdom, 2003) and the European HEATCO recommendations (HEATCO, 2006), however, it is difficult for the reader to unravel why this is reasonable.

Some Guidelines emphasize the judgmental character of the determination of the discount rate (particularly the Norwegian Guideline), whereas other Guidelines de-emphasize the judgmental character (particularly the British Guideline). For instance, the British Guideline articulates that: '*the available evidence suggests that the elasticity of marginal utility of consumptions (μ) is around 1*'. Although this quotation articulates that this parameter is not based on unambiguous evidence from the literature, it is difficult for the reader to grasp the judgmental character as a result of the 'evidence speaks for itself' kind of description. Perhaps, the reader might not even notice the judgmental character at all.

This study reveals that the Swedish and Danish discounting policies, especially, were the result of political-administrative negotiations. However, this was not revealed in the Guidelines, which makes it impossible for the reader to unravel that political-administrative bargaining played a decisive role in setting the discount rate. The political-administrative character of establishing discounting policies is rarely discussed in the literature. However, there is one noticeable exception being the paper of Henderson and Bateman (1995), which concludes that the *'discount rate for a given project or project sector has never been a question determined through a rigorous calculus, but rather it has been an issue played out within and between branches of government, occasionally surfacing as an explicit political decision.'* Henderson and Bateman discuss various examples of processes in which the discounting policies are the result of political bargaining, discretionary judgment and narrow interest group manipulation.

What are the implications of the observation that political-administrative arguments underpinning discounting policies are not communicated to readers? And what is the implication of the observation that the judgmental character of discounting policies is poorly underpinned and sometimes de-emphasized? To be clear, the judgmental character in itself is not problematic and should not have any implications. As discussed, determining the discount rate is always an ethical decision which makes CBA intrinsically a normative instrument. Even the decision to base the discount rate solely on empirical information is an ethical decision. However, problems (and implications) arise when the judgmental or political character of the discount rate – and thus CBA studies – is poorly communicated to Members of Parliament and/or other actors and institutions who aspire to use the outcomes of CBA as input in their decisions (or viewpoints) on candidate infrastructure projects. If members are uninformed they cannot take this into consideration when forming their judgment on the extent to which CBA provides useful input for their decision on a transport project (Goulder and Williams, 2012; Kaplow et al., 2010). When the judgmental aspects of the discount rate are not made explicit, this can prevent Members of Parliament from assessing the judgments made, from disagreeing with this judgment and from asking for a recalculation of the CBA based on a discount rate which coincides with their own value judgment.

Various scholars argue that providing decision makers with suboptimal information is a problem, particularly when they would have taken a different decision in a state of affairs in which they had received better information (e.g. Nicolaisen, 2012; van Wee, 2011). When it turns out that Members of Parliament disagree with the judgments made when choosing the discount rate, it is

conceivable that this influences their decisions, because seemingly small differences in the discount rate can yield different CBA outcomes and thus policy recommendations (e.g. Heal and Millner, 2014). CBA even runs the risk of becoming a politically biased instrument when poor communication with respect to the judgmental character of the discount rate favors the stakes of institutions/politicians who made (or agree with) the judgments and harms the stakes of those who disagree with the judgment.

In conclusion, there is nothing wrong with using judgment when determining discount rates as long as it is articulated well enough to warrant that the CBA users would not make different decisions if the judgment were articulated in a more explicit way. How can the communication of the judgmental character be improved? Several scholars (e.g. Goulder and Williams, 2012; Kaplow et al., 2010) argue for a clean separation of empirical and normative arguments in discounting policies. This makes discounting policies more transparent and easier to interpret. Moreover, the normative arguments should be thoroughly underpinned to give the reader the opportunity to agree or disagree with the judgments. For the same reasons, it should be communicated as to whether or not the nature of the judgment is ethical ("for ethical reasons A and B we select this discount rate") or political ("a low discount rate was selected, since this positively affects CBA outcomes of transport projects"). Moreover, Kaplow et al. (2010) argue that it is important to do sensitivity analyses on the normative judgments in the discounting policy and to inform the reader about alternative CBA outcomes based on these sensitivity analyses. This permits the reader to consider the CBA score which coincides with his belief system. In addition, they propose carrying out sensitivity analyses when an element of the discount rate 'is' grounded in empirical information but 'could be' based on ethical views, since this enables the reader with ethical views that do not coincide with empirical information to make their own assessment.[5] According to Kaplow et al. (2010) sensitivity analysis is often used when empirical parameters are uncertain, but the method is rarely used to analyze the impacts of diverging ethical judgments. Another solution to improve the communication of the judgmental character of determining discount rates is to involve the most important users of CBA being Members of Parliament in the process of making the judgment. This can be an effective solution to enhance the Members of Parliament's understanding with respect to the judgmental character. A compelling argument for empowering Parliament with the responsibility to make this judgment is the fact that determining the discount rate is in essence a decision on the trade-off that should be made between the utility of the current generation and the utility of future generations and in western democracies Parliament is elected to make important moral trade-offs regarding social welfare an example being trading off well-being of generations.

Besides empirical, judgmental and political-administrative arguments, the Swedish discounting policy was partly established based on practical arguments. The argument for not incorporating declining discount rates in Sweden is that the modelling tools used for CBA are not designed to handle discount rates that are variable over time (Swedish Transport Administration, 2012). This argument is peculiar, since it should be relatively easy to implement a declining risk-free discount rate in CBA modelling tools. Bearing in mind the decisive character of discount rates, this practical obstacle should be rectified.

8. Conclusions and further research

[5] Examples of ethical arguments are discussed in section 3.2.

This study concludes that discounting policies in the Netherlands, the United Kingdom, Norway, Sweden and Denmark vary significantly. Although the resulting discount rate schedules of the Scandinavian countries and the United Kingdom appear to be rather similar, the differences can significantly affect net present values. Moreover, it was shown that empirical observations and academic studies do not exhaustively explain these differences. Empirical arguments, practical arguments, political-administrative arguments and (differences in) judgment explain why discount rates differ.

Another conclusion of this paper is that the empirical arguments which underpin the discounting policies contradict with existing literature. The implication of this result is that the countries under scrutiny in this study possibly carry out CBAs based on incorrect discount rates, which contests the validity of the CBA results. Hence, it is recommended that the elements of the discounting policies which contradict with the existing literature should be critically assessed and reconsidered.

Since CBA is intrinsically a normative instrument, the political-administrative and judgmental character of discounting policies in itself is not a problem, as long as this is articulated in the Guidelines. However, this study concludes that the political and judgmental character of discounting policies is poorly communicated, which prevents decision makers from assessing the judgments made, from disagreeing with this judgment and from asking for a recalculation of the CBA based on a discount rate which coincides with their own belief system. In this paper, solutions for improving the communication of the judgmental character are discussed. First and foremost, appraisal Guidelines (and reports) should make it clear that CBA is a normative instrument and that the most decisive parameter is partly based on judgment. Moreover, the normative arguments should be thoroughly underpinned to give the reader the opportunity to agree or disagree with the judgments. In addition, carrying out sensitivity analyses on the normative judgments in the discounting policy can inform the reader about alternative CBA outcomes based on alternative ethical judgments. This enables the reader to consider the CBA score which coincides with his belief system. Another solution to improve the communication of the judgmental character of determining discount rates discussed in this paper is to involve the most important users of CBA being Members of Parliament in the process of making the judgment. This can be an effective solution to enhance Members of Parliament's understanding with respect to the judgmental character.

The findings of this study lead to several questions which may be scrutinized in further research, examples being: '*What explains the contradictions between discounting policies and the literature?*', '*Why are ethical arguments not considered in the Guidelines?*', '*Why is the judgmental character of discounting policies de-emphasized in the Guidelines?*', '*To which extent do Members of Parliament and other actors agree with the judgments made in current discounting policies?*' Moreover, it is not clear whether the findings of this study are fully generalizable to other countries, which is an interesting avenue for further research. Further research may also focus on fostering the unambiguousness of the empirical evidence on which the discount rate is founded. When a country uses the Ramsey equation for estimating the risk-free discount rate, an important way to attain this goal is estimating the parameters of the Ramsey equation using local data. Just as estimations of the Value of Travel Time Savings are established based on a study which is specifically carried out to estimate this parameter in each of the countries under scrutiny (e.g. Börjesson and Eliasson, 2014; Significance et al., 2012), the people who are charged with deciding on the discount rate should be provided with a sophisticated empirical study which is specifically carried out for this purpose when contemplating their judgment. Naturally, even extensive studies will not resolve the ethical conflict

which is intrinsic to the question of how to discount the future. As Amartya Sen (2010) noted, "Even the most vigorous critical examination can still leave conflicting arguments that are not eliminated by impartial scrutiny."

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